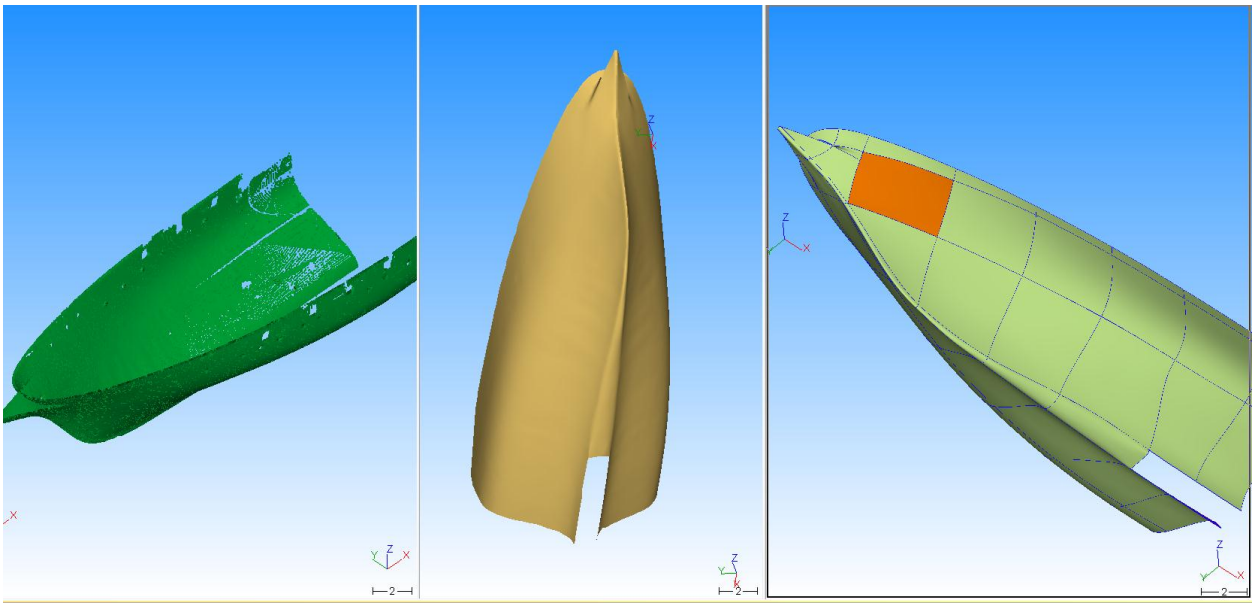
Exercise 5: Reverse Engineering

Reshaper V7...



The polygonal mesh modeling of 3DReshaper generates quality models, made up with hundreds or thousands of triangles. These 3D meshed models are ready for rapid prototyping, tool path generation, simulation, analysis…

But because of reverse-engineering needs, you may generate a CAD model (such as IGES or STEP) from a digitization, usable in computer-aided design, manufacturing or engineering software.

3DReshaper is a complete software solution which offers all the necessary functions for the construction and the processing of BSpline and Nurbs surfaces in order to output a typical CAD model.

In this exercise, we will see how to convert a meshed model into a CAD model. The process will be as following:

- Creating a set of lines from the mesh to design patches (*the meshing process has been already done from the point cloud*).
- Using automatic features such as “Sections” and “Contours” (“Feature line” will not be used in this example).
- Using manual features such as “Projected Lines” and “Stretch Contour”.
- Running the BSpline curves and Nurbs surfaces generation
- Restart patches creation.
- CAD export.

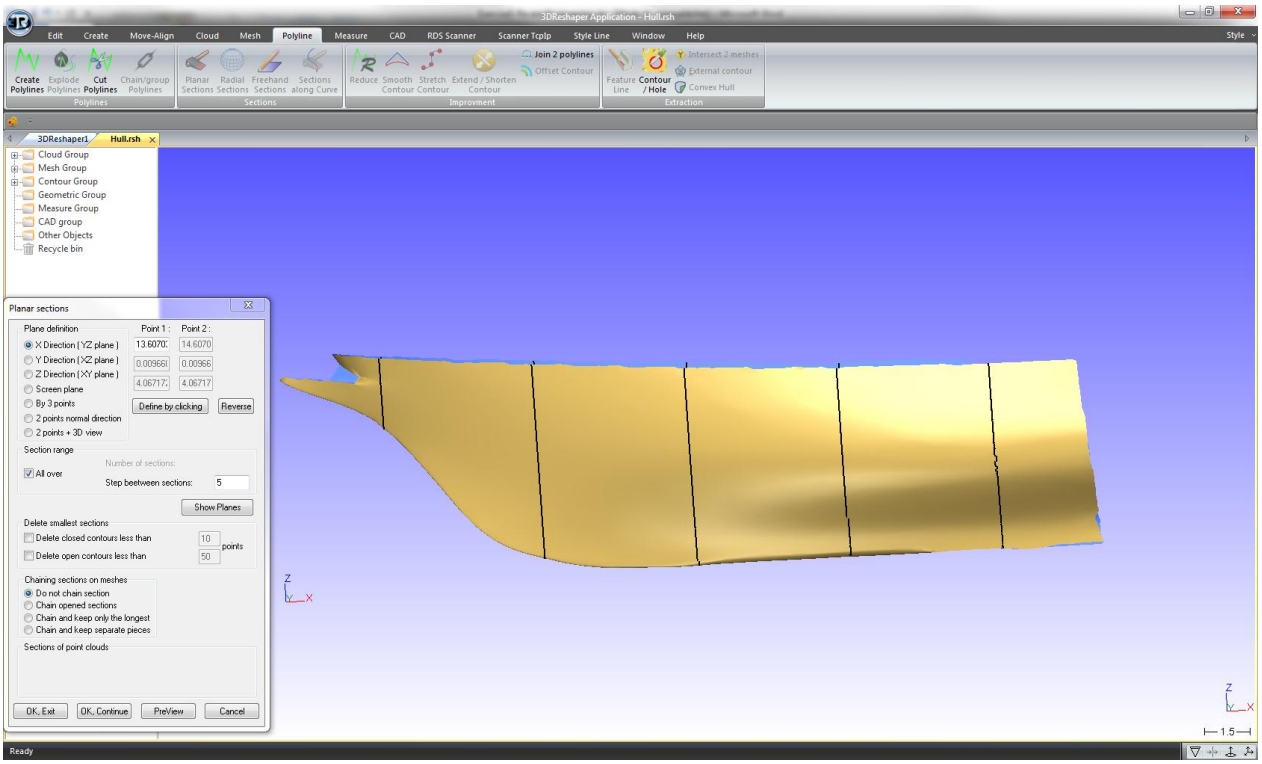
The main process, is as mush as possible, to make rectangular contours when you design patches, while keeping the continuity of the curve network in terms of radius and connections.

➢ Open the file or drag and drop*: 3DReshaper-Practise/ReverseEngineering/Hull.rsh*

You start directly from the meshed model.

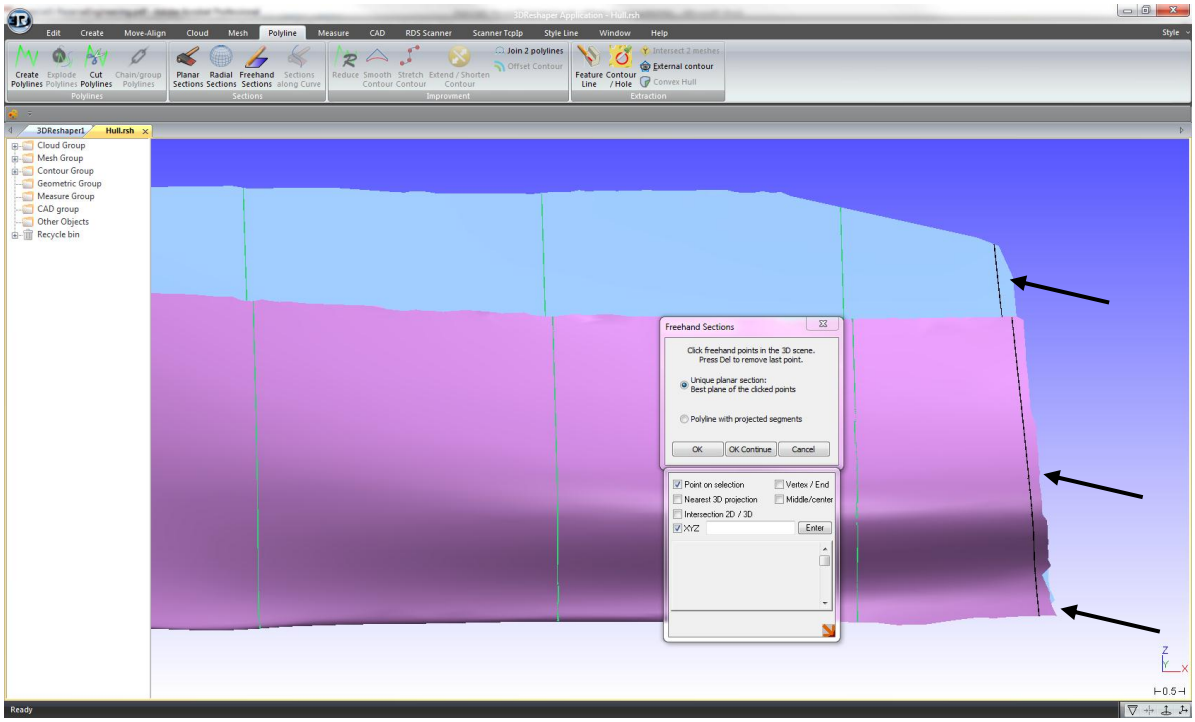
➢ Make planar sections : Polyline Menu – Planar Sections

Make some planar sections on the YZ plane all over the model and then and **"Explode Polylines"** to separate them. Thus you have automatically created the first set of lines.



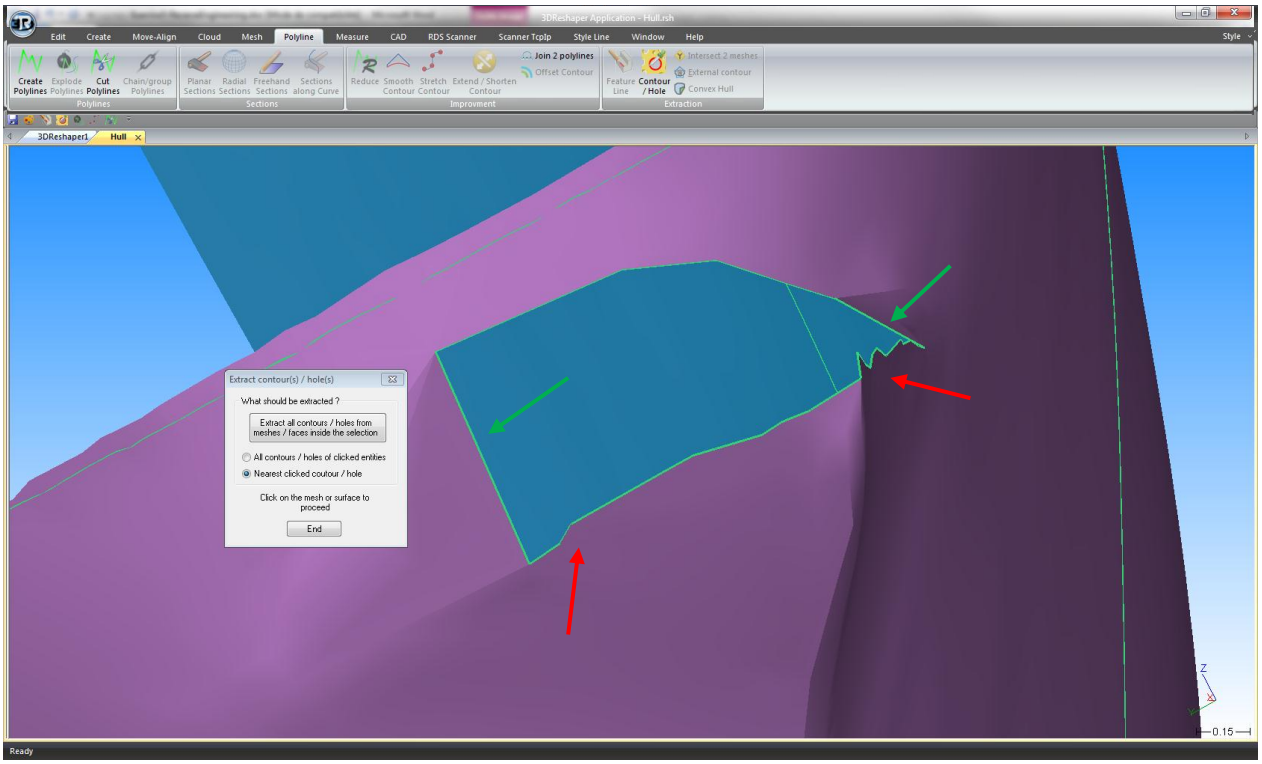
➢ Make planar sections : Polyline Menu – Freehand Sections

Make a freehand section to draw a polyline just before the back contour as this one is too jagged to be considered in the patch creation process.

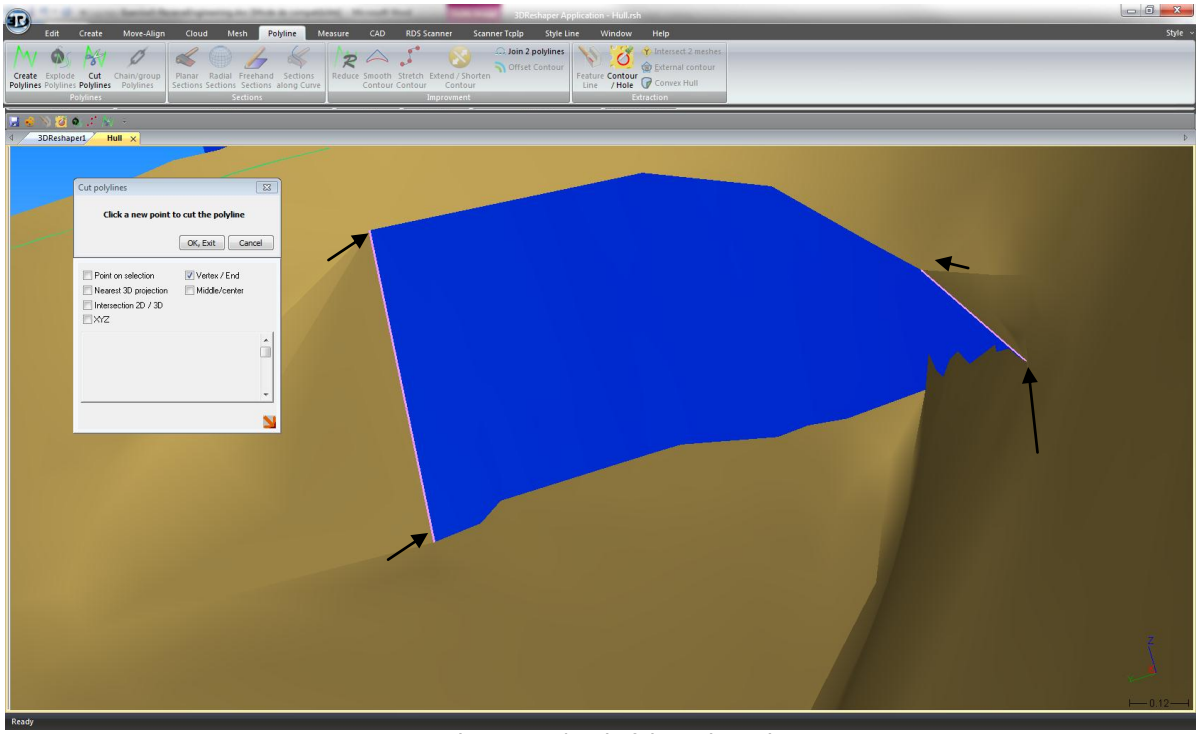


Click 3 points as indicated by the black arrows.

➢ Extract the contour on the bow: Polyline Menu – "Extract Contour". Then Separate the contour in 2 distinct lines: Polyline Menu – "Cut Polylines".



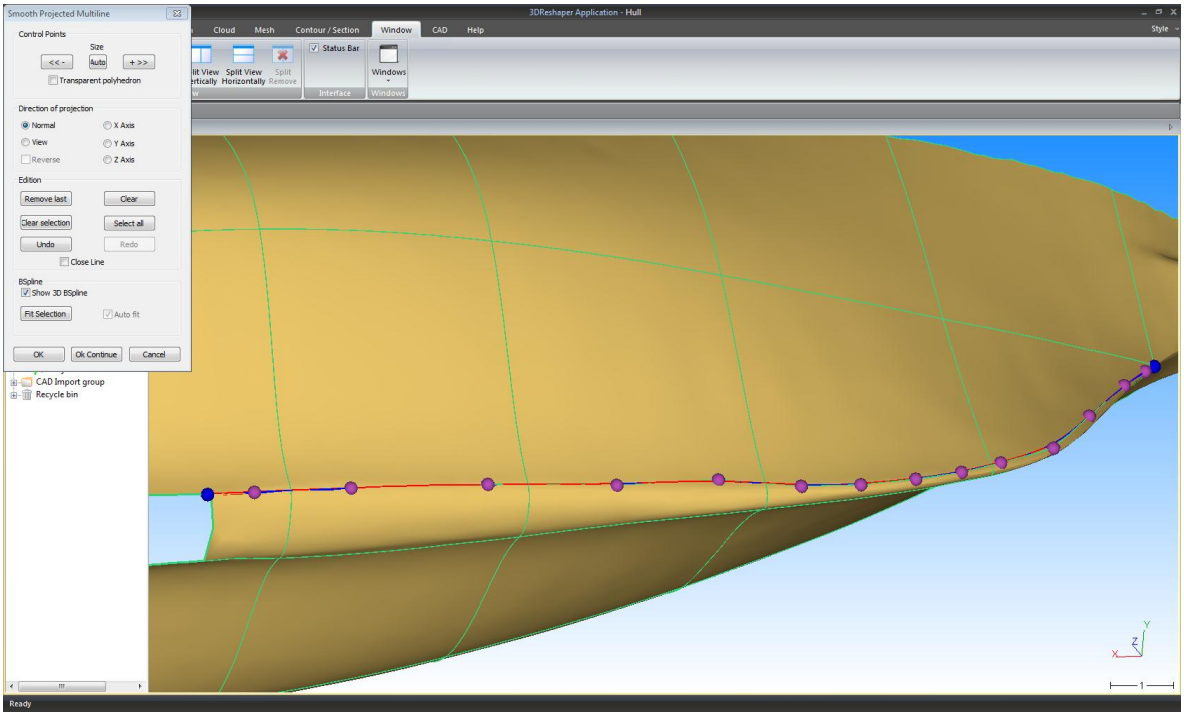
As it is depicted in the above image, the contour does not have continuous borders (red arrows). Thus you must keep only the continuous parts (showed with the green arrows). A jagged contour will degrade the final average accuracy of the surface generation.
That is why; you must either separate the contour line, keeping the appropriate segments and/or draw a projected line just above or beneath the jagged contour to exclude it in the surface generation process (see in the “Projected Contour” of the CAD menu).



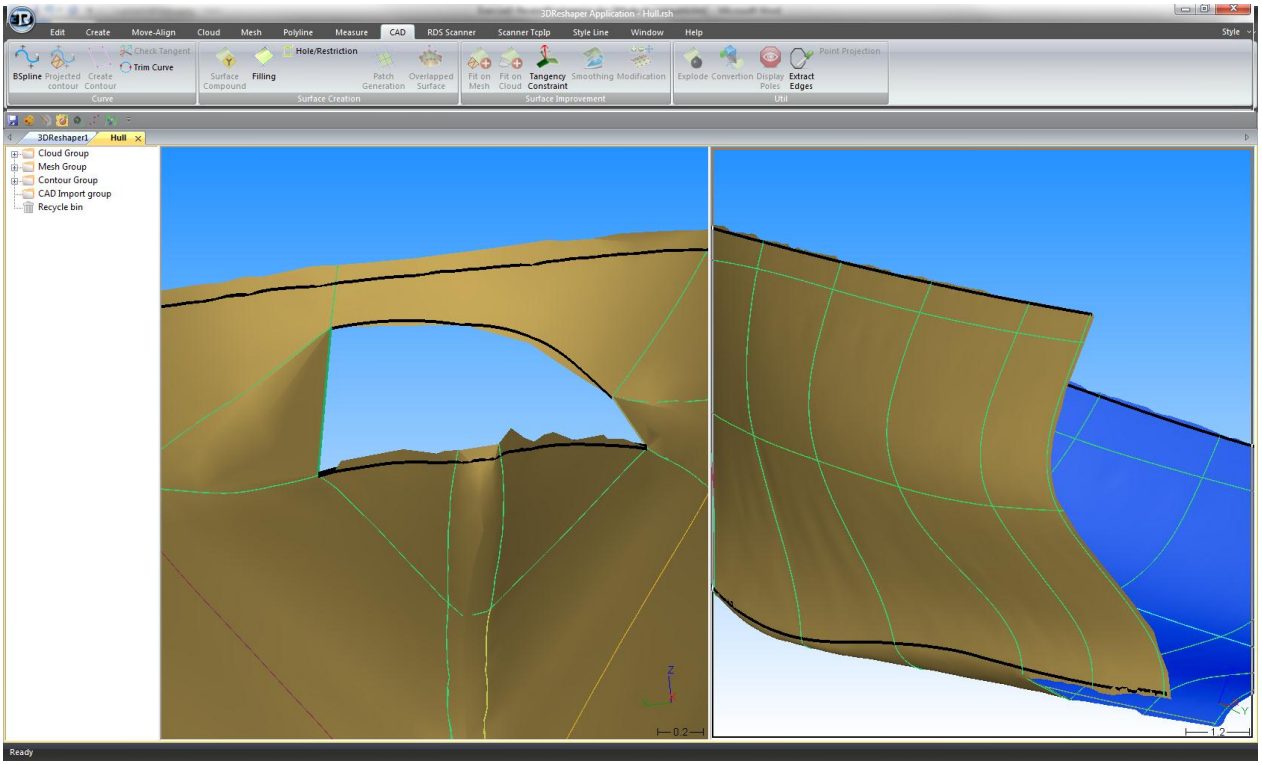
Cut on the Vertex/End of the selected segments.

➢ Select in the CAD Menu, ”Projected contour”

Use the projected line to manually design your curve network. Try to draw where there are some discontinuities on the surface (tangency or curvature discontinuity); try connecting the line to existing continuous intersections.



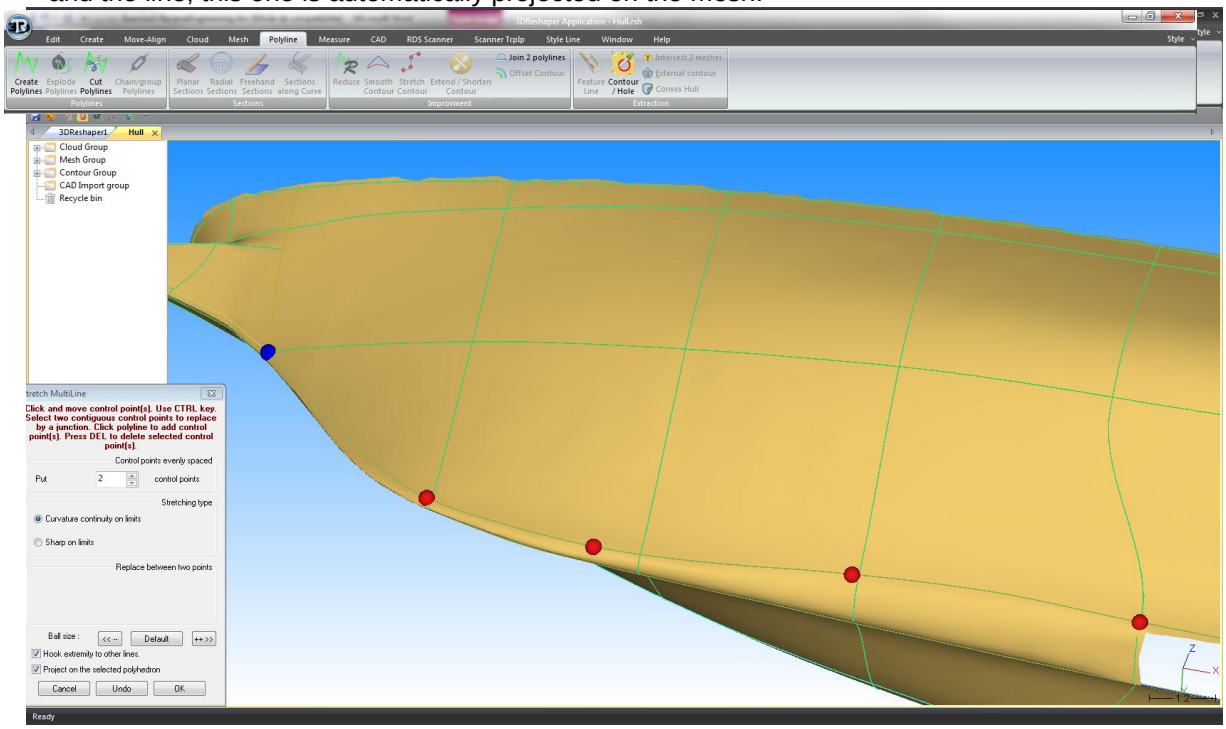
The blue balls show that the line is connected at both ends. The control point size can be changed and the last control point can be deleted with the DEL key. Note that the curve is placed on the limit between two radii (curvature discontinuity).

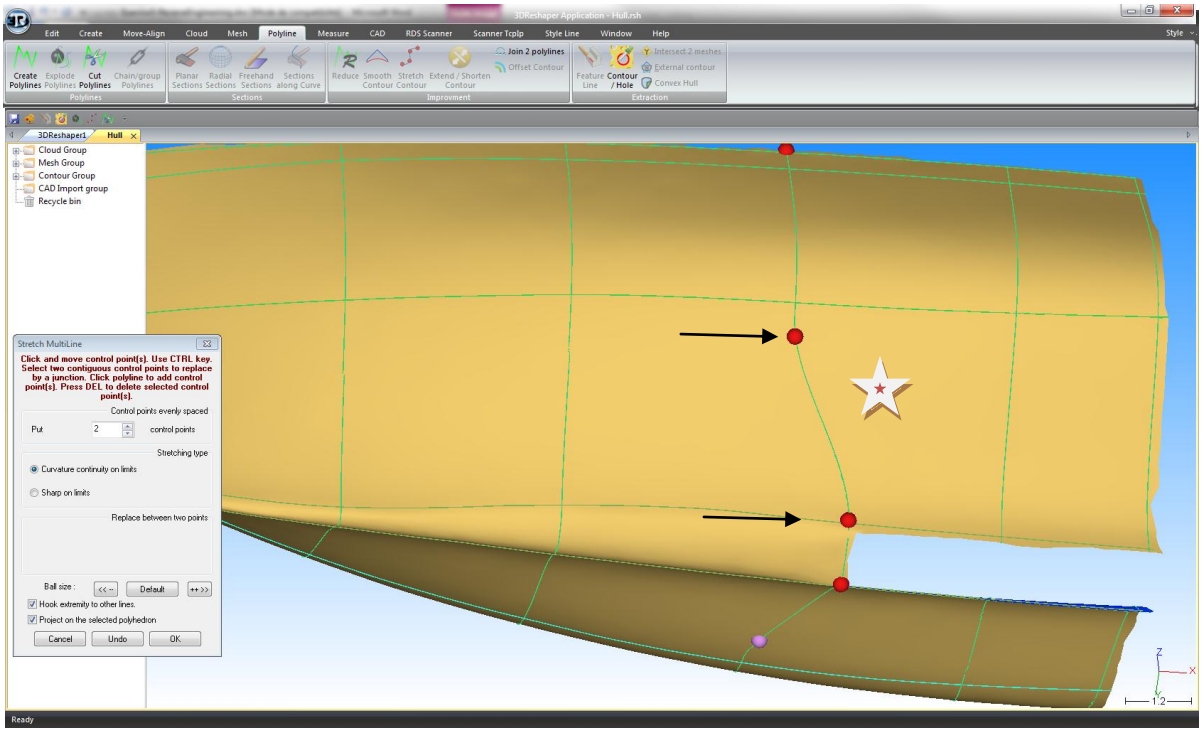


Draw projected lines very close to the jagged contour in order to create continuous patch borders.

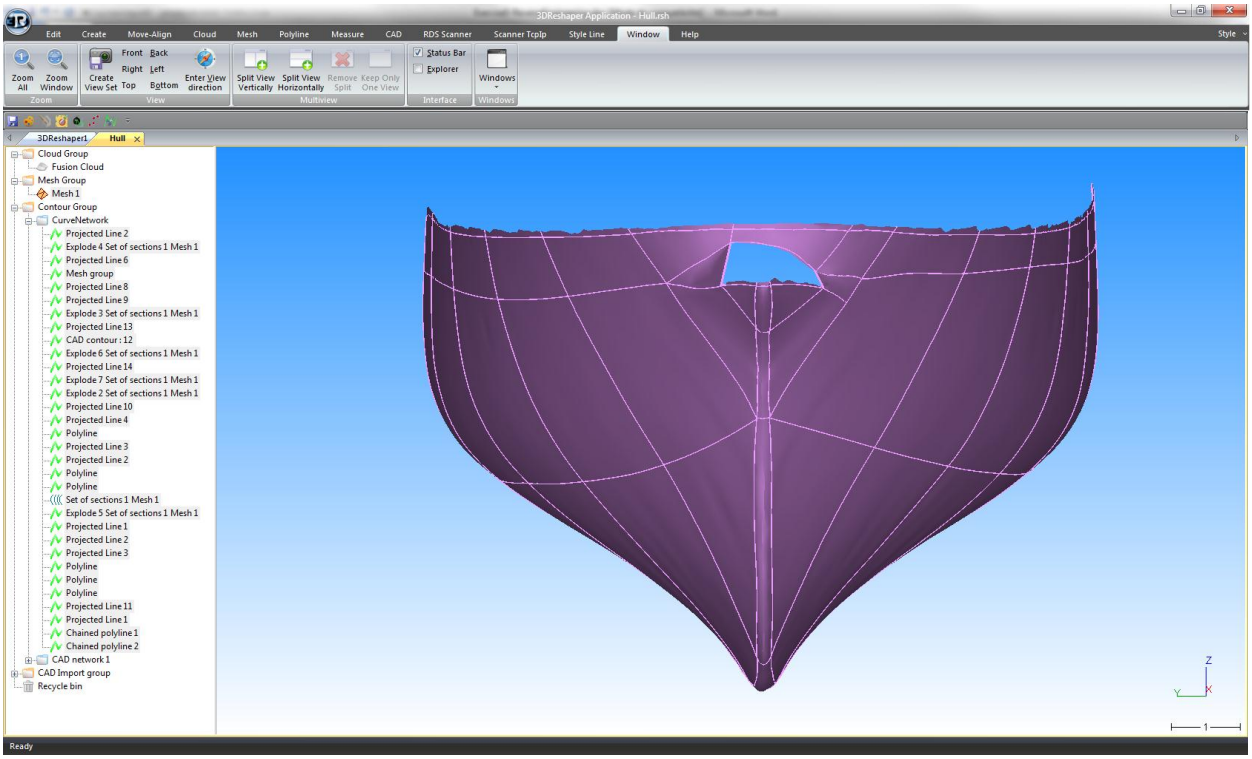
➢ Select the two objects (mesh and polyline) – Go to the Polyline Menu and use "Stretch Contour".

This feature helps you to stretch the polyline with control points. The blue color also indicates that the line is connected; which is necessary for the network drawing process. You can add as many control points as you want (Ctrl key) and reduce or use the default ball size. When selecting both the mesh and the line, this one is automatically projected on the mesh.

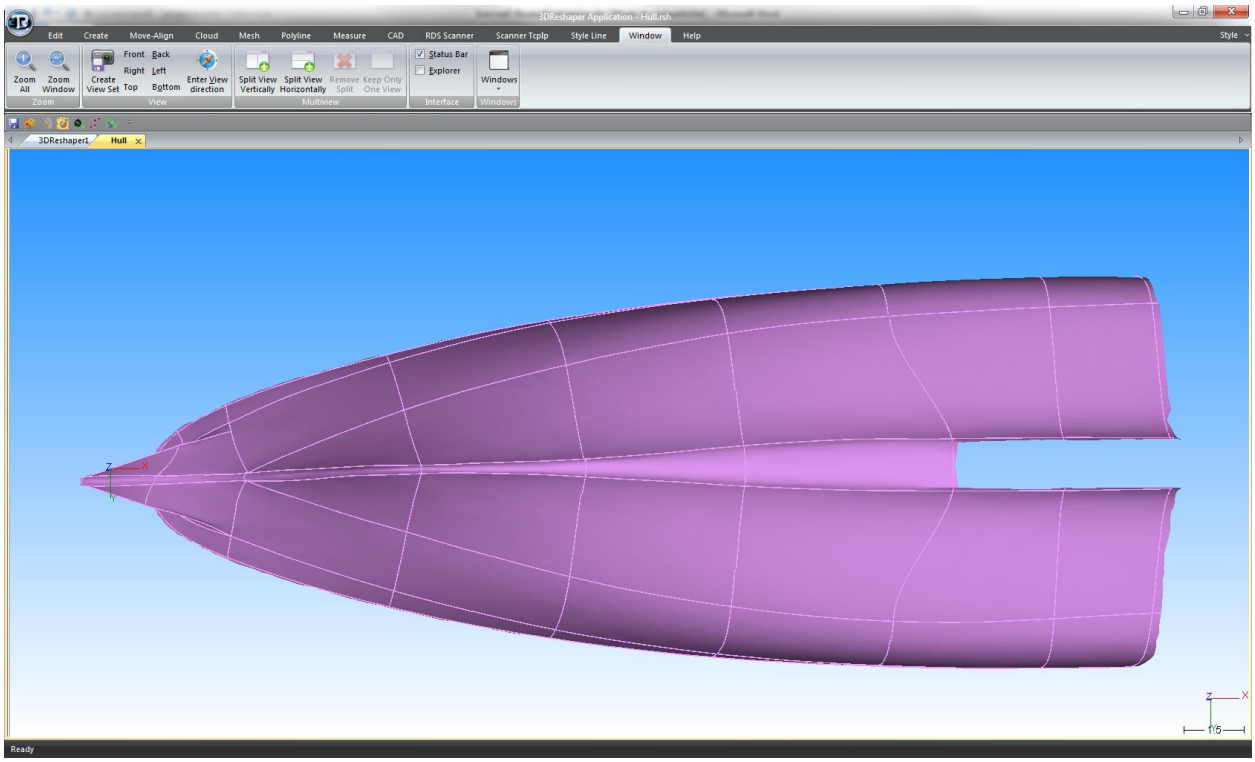




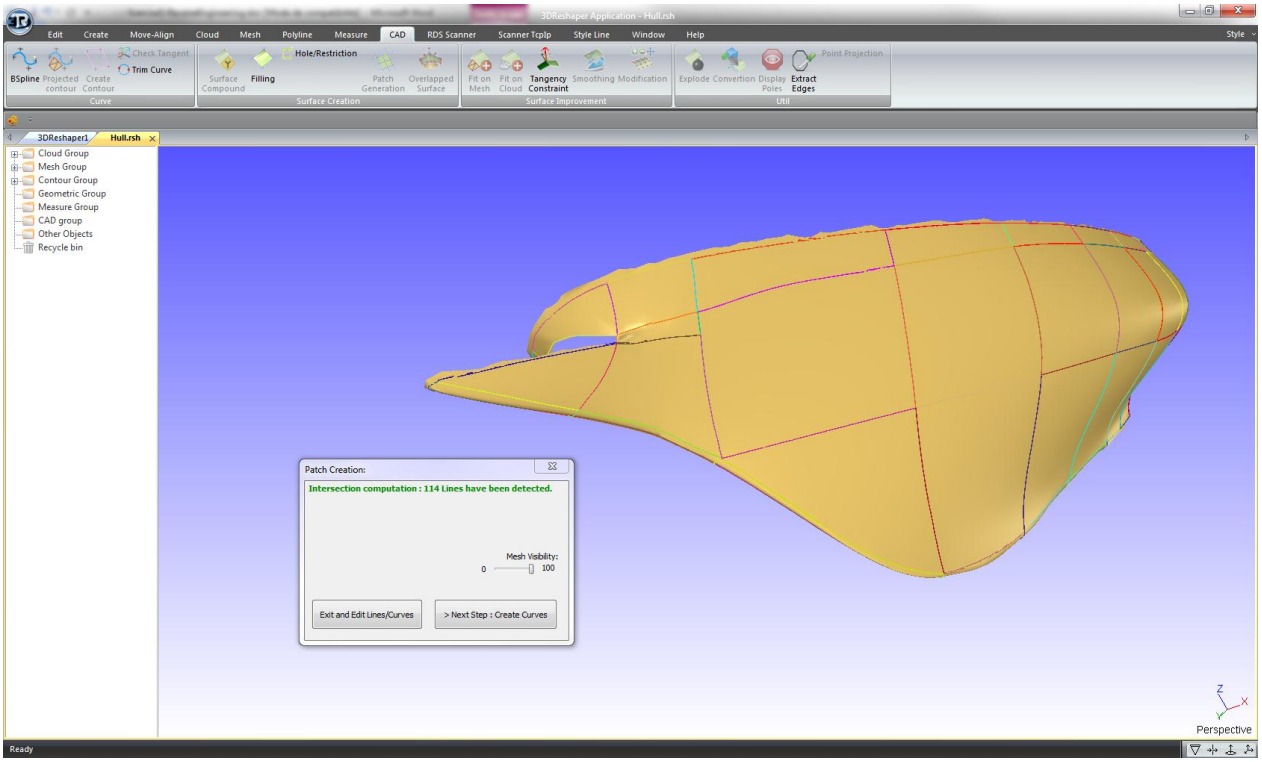
Stretch this line (former section) using two control points at the same time (CTRL key), to improve the creation of this patch.



The above image illustrates a possible curve network. The number of lines can be higher on areas where there are many changes of curvature radius.



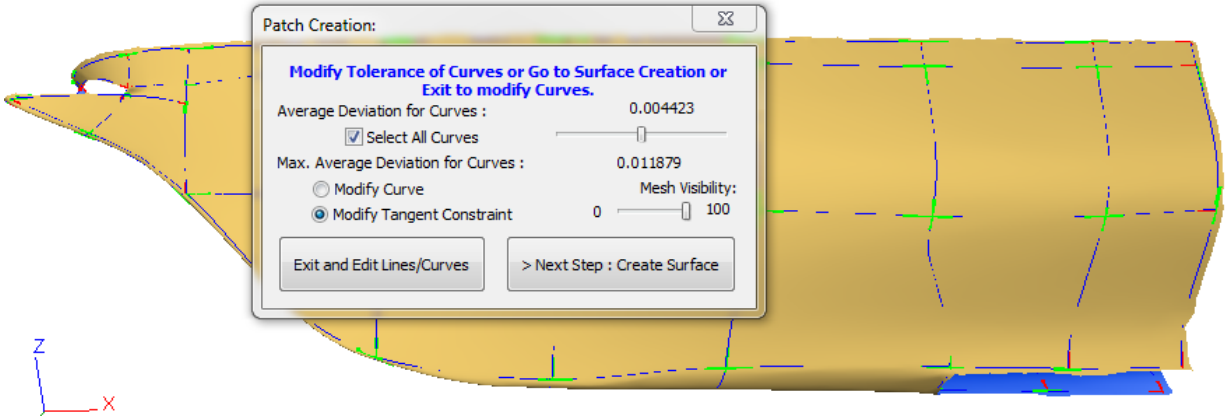
- **Select all useful polylines and the mesh (through the 3D scene or in the arborescence). Go to the CAD module and launch "Patch Generation".**



This is the first main step once the curve network has been done. The software computes the intersections and displays the hundred of lines used to be converted into BSpline curves. At this step, you can come back to modify your network or keep processing. The displayed lines are the ones which are interconnected. In the above image, the 3D model is displayed in perspective view.

➢ Create CAD curves

3DReshaper generates BSpline curves. This is the second step.



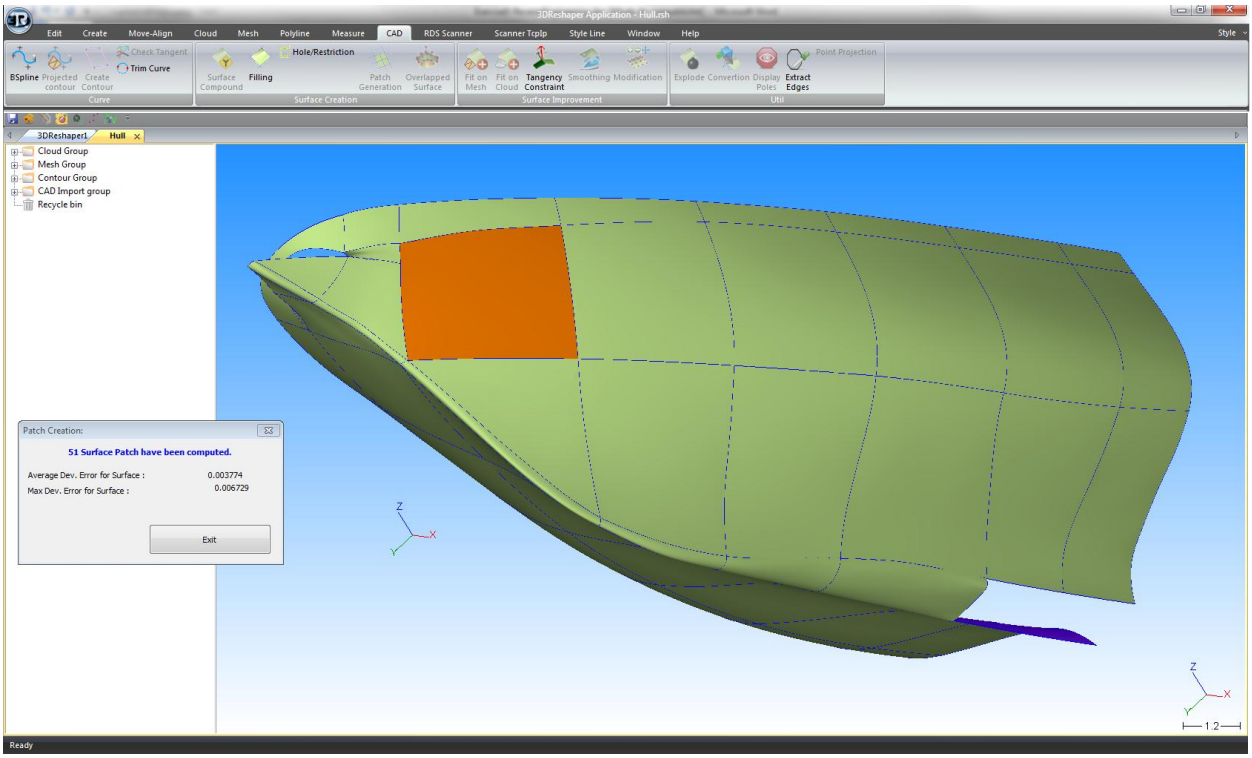
At this step, you have several possibilities:

- Change the deviation of the curve approximation for all curves or for particular curves that you can select individually.
- Modify the tangent constraints that Reshaper has automatically determined. It can happen that some tangency conditions are incorrectly set and in this case you can click on curve extremities to set or release tangency constraints.
- You can exit the command to edit manually some of the BSpline curves.
- Create curves

➢ Create CAD Surfaces

We will continue the model generation by clicking “Next step”.

Now, your model is made up of 51 surface patches. The different colors (green, orange and red but not in this case) indicate the level of the surface restriction that has been potentially completed.



You can delete the possible surface created on the hole of the prow.

Green = ok, the created surface corresponds with the 3 or 4 border patch. However, note that the patches with 3 border may have a disapointing quality sometimes.
Orange = ok but a fusion of at least one border has been executed (Reshaper detected merge serveral curves together because they were continuous)
Red= The contour is made of more than 4 sides and Reshaper did generate a trimmed patch (4 sided patch bigger than the area to cover restricted by the contour).

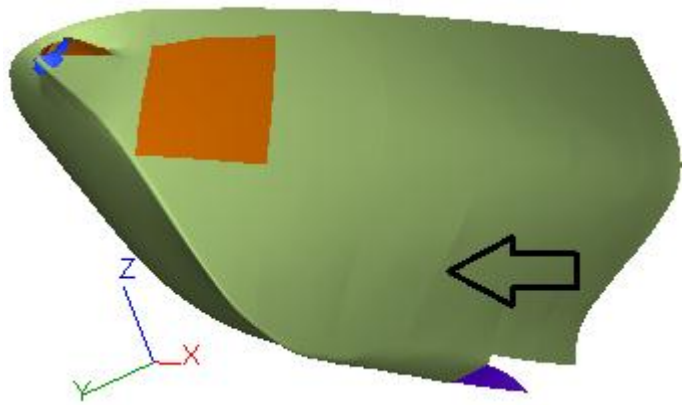
➢ Adjust the continuity between patches

Once you have the result on the screen, you have two type of objects:

- CAD curves.
- Patches.

You can develop the CAD group of your object explorer and see the face and curve folder that were just created.

- Select the “Mesh 1 face” folder.
- Right click to show only the patches.



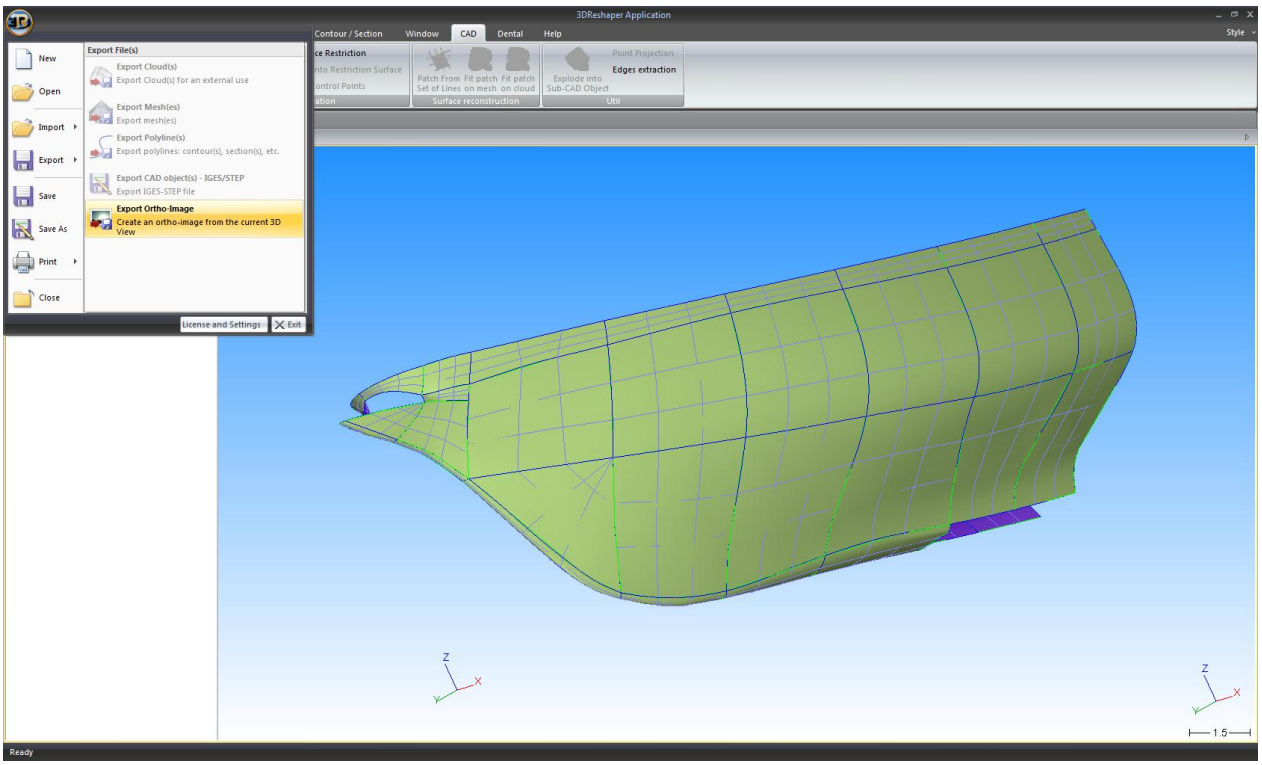
If you look at the model in grazing conditions you can see some defects because the continuity between patches may sometimes be incorrect.

- Launch the command “**CAD -> Tangency constraint**”.
- If you click on two neighbor patches the continuity will be adjusted.
- You can also click and drag over the patches like a paint brush to obtain a more rapid result if you need to cover a big area.
- You have also the possibility to locally improve the surface patch by using the smoothing and Modification functions.

➢ Create a CAD compound

To handle a surface it is usually more easy to have one surface that many exploded patches.

- Select all the patches.
- Launch the command “**CAD -> Surface compound**”.
- Answer no to the question if patches created by the command “**patch creation**” are normally correctly oriented.



You can make a surface compound in order to have one single surface composed of 51 elements.

Select the CAD faces or CAD compound; export the model in IGES or STEP, or use it to make 3D comparison.